BULLETIN

OF THE

ESSEX INSTITUTE.

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REGULAR MEETING, MONDAY, May 1, 1871.

THE President in the chair. Records of preceding meeting read.

ON THE GEOLOGICAL SURVEY OF ESSEX COUNTY.

Prof. ALPHEUS HYATT showed a series of specimens illustrating, in part, the geology of this county, also a geological map of Marblehead Neck, and offered some interesting remarks in relation thereto, of which the following is an abstract.

This society has had in view for many years past the thorough exposition of the history of this county, both political and physical.

The political history has been well advanced by the numerous papers and essays of prominent members; so also has the Natural History. No attempt could be made however to organize a survey which would strike directly at the accomplishment of this object until funds were provided for the employment of a corps of men and the publication of the results in a systematic manner.

When the Peabody Academy was founded and the collections of this society handed over to its keeping, the

idea of a general Natural History Survey was for the first time definitely announced and provided for in its plan of organization. The Geology fell to my share, and since my acceptance of a position in the Massachusetts Institute of Technology, I have, with the assistance of the fourth year's class of Mining Engineers from that Institution, been able to continue the work.

The first fruit of this labor is exhibited here to-night in a map of Marblehead Neck. The ground-work of the whole is a copy of the Plane Table sheet of the United States Coast Survey, which has been given to me especially for this work through the kindness of Prof. Pierce. The wonderful accuracy of this map is shown by the test to which these investigations have subjected it. The copy before you has been enlarged three times, and is on a scale of .3000 or about eighteen inches to the mile. Notwithstanding this enlargement I have been able to identify every small indentation in the coast-line, and the outline of every projection; as a topographical map for the foundation of a geological survey it is perfect.

The principal intention has been to map out in detail the actual outcrops of rock which project above the surface. These are painted in solid colors. Dark bluish purple shows the porphyry, which occupies the upper two-thirds of the neck and a strip on the harbor-side, reaching to the east end of Devereux beach; dark drab mica-schists and fine-grained gneiss, which fill out the southeastern portion; while patches of vermilion scattered over both indicate the presence of an eruptive granite.

The precise outline of each outcropping or exposed rock was not attempted, but the general direction of the longest axis of each mass is given, and such an approximation to the precise outlines as could be obtained by a

sketch taken on the spot. These are connected by ground shades of the same color, but lighter hue, which indicate to the experienced eye the character of the rock lying under the soil. Thus the theoretical conclusions are separable from the observed facts, and every person can see the face of the country as it is, the conventional signs and colors being readily translated by the table attached to the sheet.

Marblehead Neck was selected as the initial point, because it is one of the three porphyry outcrops within the limits of this county, and from these it is convenient to lay our courses in order to meet the regularly stratified rocks which lie to the westward.

It would be premature at this stage of the investigation to endeavor to forestall the results which may be finally worked out, but it is possible to make certain statements of considerable interest.

The porphyry of our vicinity whether Lynn, Marblehead or Newburyport is a recomposed rock, a conglomerate composed of more or less rounded pebbles of more ancient banded porphyry. Taking our departure from these points we meet in the neighborhood of Newburyport with a transition rock made up partly of porphyry, and then with stratified diorites and slates, which surround the porphyry outcrop on the sea-face, and stretch up to the north and south of Kent's Island, and are lost in the marshes.

The northwesterly dip, and northeasterly strike of these diorites and slates, and the presence of slate rocks in Topsfield and Middleton, are difficult to account for unless we imagine the porphyries to be interstratified with them. The succession of the strata in this part of the county then would be Eozoönal limestones and serpentines, then slates, then the porphyries of Kent's Island

and Lynn, then slates and diorites, and lastly, the porphyries of Marblehead Neck. Either this is the explanation or else we have several anticlinal axes or folds in the porphyry. In either case all the porphyries are probably older than the Eozoönal rocks of Newburyport, and underlie them. The porphyry of Marblehead Neck has the stratified micaceous rocks, mentioned above, lying upon its southeastern face, with dip and strike precisely conformable to the more ancient shore-line formed by the porphyry itself.

The porphyry of Lynn has upon its eastern face the outcropping edges of an enormous overflow of igneous granite, which anciently filled the valley between Peabody village and Swampscott, but which is now only represented by Prospect Hill and others on the west, and patches which still remain plastered against the western sides of the hills to the east.

The farther or westerly side of this porphyry, as also of the Newburyport exposure, is occupied by a series of rocks with a regular northwesterly and southeasterly trend. These overlie the series of serpentines and limestones which crop out so abundantly at Newburyport and Lynnfield. At this last locality the relation of these lime rocks to the porphyries is obscured by masses of what I am disposed to consider an eruptive granite. In fact, all the difficulties of the survey have arisen from the enormous sheet, or rather, sheets of igneous rocks, for there seems to have been several which overspread the surface of the country.

The principal seat of one of these eruptions, and perhaps two of them, can be traced to a large part of Marblehead and the whole of Salem township. The rock underlying these localities is a dense, dark hornblendic, often micaceous granite, varying in many places to lighter

colored and more crystalline. This is, accurately speaking, shivered to pieces by eruptive forces, which have at the same time filled the numberless crevices and hollows between the fragments with one form of the igneous granite alluded to. This is always lighter colored, and often reddish on account of its flesh-colored feldspar. There are perhaps eight or ten square miles of this broken rock, and yet in many places, if the injected granite were removed, every dissevered piece of the dark granite would fit together edge to edge like a consolidated block-puzzle.

It is only fitting here to say that the successful prosecution of the survey must be largely attributed to the encouragement and assistance of Dr. Sterry Hunt. The communication made by this gentleman at the Salem meeting of the American Association, upon the rocks of this region, incited Mr. Bicknell to renew his formerly unsuccessful search at Newburyport for the Eozoön. The subsequent discovery of this fossil and the beginning of the field work were the indirect consequences of this and of his subsequent visits. The President and Directors of the Eastern Railroad have also substantially assisted in the progress of the survey and I have personally received aid from others to whom my indebtedness will be duly acknowledged in more formal publications.

Note by Dr. T. Sterry Hunt. In a communication to the *Boston Natural History Society* on the 19th of October last, and subsequently in the *American Journal of Science* for February and March, 1871 (pages 84 and 182), I have expressed the opinion that the porphyries of the eastern coast of Massachusetts, are stratified rocks, belonging together with their associated diorites and slates (greenstones, chloritic and epidotic rocks), to the

Huronian system, or Green Mountain system. As regards the limestones with Eozoön, from eastern Massachusetts, which in the *American Journal* for Jan., 1870, I referred to the more ancient Laurentian system. I have in that same journal for July, 1870, pointed out the fact that the Eozoön of Hastings county, Ontario, occurs in a series of crystalline schists which I consider newer than the Huronian, and the equivalent of the White Mountain gneisses and mica-schists, so that, as I there remark, "the presence of this fossil can no longer serve to identify the Laurentian system. It will be remembered that the *Eozoön Bavaricum* of Gümbel occurs in Bohemia, in a series of crystalline schists above the Laurentian, occupying probably the position of one or the other newer systems just mentioned. I have in the *American Journal* for last March (page 183), moreover, called attention to the fact that the crystalline limestones which are associated with the White Mountain or Terranovan system in Maine, closely resemble in mineralogical characters those of the Laurentian. It will therefore remain for farther study, to determine how far the crystalline limestones of eastern Massachusetts belong to the Laurentian, and whether some of them are not included in one or the other of the newer systems of crystalline schists. The porphyry conglomerate noticed by the late President Hitchcock and described by Prof. Hyatt, are referred to in my paper of last October, mentioned above. This rock is, I conceive, to be distinguished from the old Huronian porphyry, on which it often reposes, and from the ruins of which it is derived. Similar conglomerate porphyries along the shores of the Bay of Fundy appear to be of Upper Silurian age.

GEOLOGY OF THE PHOSPHATE BEDS OF SOUTH CAROLINA.

Dr. A. S. Packard, Jr., made some remarks on the geology of the phosphate beds of South Carolina. During a recent visit to Charleston, he had observed the phosphate diggings on the Ashley river, and at a locality on the northeast railroad eight miles from Charleston, but through the courtesy of C. C. Coe, Esq., Superintendent of the Marine and River Phosphate Mining and Manufacturing Company, and Dr. C. U. Shepard, Jr., he had enjoyed special facilities for studying the Quaternary, or Post Pliocene formation in which the phosphate bed occurs, having made two excursions in company with these gentlemen on the Company's steamer Gazelle. He was also indebted to Prof. C. U. Shepard, Sr., for much valuable information regarding the chemical as well as geological history of these interesting beds. Analogous beds have been discovered in the later tertiary of England near Cambridge, but they are becoming exhausted, and manufacturers of superphosphates are now importing large quantities of the crude phosphate rock from Charleston, S. C., as well as the phosphate, or apatite, rock from the Laurentian formation of Canada, which Dr. T. Sterry Hunt, the distinguished chemist of the Canadian Geological Survey, believes to have resulted largely from the decomposition of shells, especially those of Lingula.

The phosphate beds of South Carolina are spread over an area along the coast one hundred miles along, and about twenty miles in breadth; the formation is not continuous, being sometimes, as stated (in conversation) by Prof. C. U. Shepard, Jr., replaced by ferruginous sand. It has already been largely used as a fertilizer for worn out lands of the sea island cotton region, and promises from the unlimited supply of the rock, to become a large

industrial interest of the state, six million dollars having already been invested in lands and mining and manufacturing materials by northern capitalists alone.

The relation of the phosphate beds to the Quaternary formation of the state and of the latter to the glacial beds of sand and clay of the northern states, were, however, the principal points he would allude to. At a celebrated locality of Quaternary fossils at Simmon's Bluff on Wadmalaw Sound, about thirty miles by steam from Charleston, he made with the kind and generous aid of Dr. Shepard, Jr., a large collection of fossils, from a bed of sand and mud about four feet in thickness. This bed corresponded with the marine clays of New England and Labrador, and the ancient sea bottom with its multitude of shells, which remained just as they had died in their holes, reminded him of an ancient raised sea-bottom at Hopedale, Labrador.

These clay beds graduated into clay and sand, containing a ferruginous layer, supposed by Dr. Shepard, Jr., to be the horizon of the phosphate beds. These beds correspond to the beds of clay at Gardiner, Maine, where Sir Charles Lyell discovered the bones of the Bison and Walrus, and contains bones of the Megalonyx, Mastodon, Elephant, Tapir, two species of Horse, Peccary, Rhinoceros and Manatee. The sands graduate into the beach sands of the close of the Quaternary, just as do the Bison and Walrus beds of the Kennebec river. The phosphate beds, then, were probably rolled masses of Eocene rock crowded with shells, mingled with the bones of the animals above mentioned, deposited and arranged by the waves of a shallow sea a few feet deep. This sea was much shallower even than that which covered the ancient sea bottom beneath, which must have been only from one to five or ten fathoms deep, as the same shells are at the

present day thrown up on the neighboring beaches in great abundance, and he had dredged some of them at a depth of from five to thirty feet at Beaufort, N. C.

After their deposition the carbonate of lime of the shell marl of the Eocene rocks had been replaced by phosphate of lime. How this had been effected, and whence the phosphate of lime was derived, was a question still unsettled by chemists. He alluded to the theory of Prof. Shaler that this phosphate deposit had been formed at the bottom of the Gulf Stream, which, according to that geologist had probably flowed over the site of the present phosphate beds; and in opposing the theory suggested that the phosphate beds were deposited in shallow water, perhaps lagoons as suggested by Prof. Holmes, as they rested in a shallow water deposit above alluded to. There was no apparent evidence, as well shown by the facts published by Tuomey in his geological survey of South Carolina, of a depression of the coast. On the other hand there is no apparent evidence of glacial action on the coast, since the Quaternary sands are marine or aerial, and Tuomey states that he has nowhere in the state of South Carolina seen any angular blocks, nor a pebble a foot in diameter. Moreover, the life of the Quaternary in this state indicated even a warmer climate than at present obtains.

Since these remarks were made, he had met by accident with the paper by Desor, than whom no one can speak with greater authority, in which he has made a comparison * between the glacial marine beds of the North and the marine coast deposits of the Southern states, parallelizing the deposits in a masterly manner. His remarks

* Post Pliocene of the Southern states and its relation to the Laurentian of the North and the deposits of the valley of the Mississippi. By E. Desor. American Jour. Sciences and Arts. 1852. Vol. 14. p. 49.

entirely confirm the views given above. One difficulty Desor had in parallelizing the Laurentian beds of the North with those of the South containing the remains of land animals, was the apparent absence of the remains of land animals in the clays of the North. But since then teeth of the bison have been found at Gardiner, Maine, in the upper part of the clays. It may also result from farther investigation that the phosphate beds were laid down at a later period than we have supposed; at the time when the great mammals found in the cave at Phœnixville by Mr. Wheatley flourished, perhaps during the earlier portion of the river terrace period when the mammoth and mastodon lived both in the northern and southern states.

Thus, the parallelism between the Quaternary beds North and South would seem to be even more exact than Desor could with his data make it twenty years ago. The climate gradually grew warmer from Labrador to Florida; the Gulf Stream did not apparently change its bed during the Quaternary period; the oscillations of level of the coast of South Carolina were slight and involved but a few feet, where in Canada and Labrador the rise and fall involved several hundreds; and the denudation effected in the North by land ice, was caused in the South by oceanic currents, waves and atmospheric agencies. There are apparently no facts to show that while the glaciers lined the coast of New England, the waters of South Carolina were not as warm, if not warmer, than at the present day, from the effects of the Gulf Stream.

Mr James H. Emerton exhibited the following species of plants in flower which he had collected this afternoon in South Salem and Swampscott, and made some appropriate remarks in relation to them.

Ranunculus sp., near the outlet of Legg's hill ponds.
Ranunculus fascicularis, hillside west of Forest River near Lynn road.
Caltha palustris.
Anemone nemorosa.
Hepatica triloba, Swampscott near Salem line. Sepals dropping from most of the flowers and new leaves half grown.
Aquilegia Canadensis, great pasture, very few flowers open.
Saxifraga Virginiensis.
Sanguinaria Canadensis, Swampscott near Salem line. Leaves as high as the flowers and many flowers without their petals.
Fragaria Virginiana, roadside near Forest River.
Houstonia cærulea.
Viola cucullata.
Viola blanda.
Acer rubrum, roadside, Swampscott.
Salix, two species on the Eastern Railroad.
Benzoin odoriferum, meadow north of Legg's hill.
Gnaphalium uliginosum, pastures and roadsides.
Erythronium Americanum, near Legg's hill.
Arisæma triphyllum, near Legg's hill.
Carex Pennsylvanica, and another species, great pasture.
Equisetum arvense, Marblehead Railroad near Lynn road.
Equisetum sylvaticum, near Legg's hill with *Erythronium Americanum*.

The Secretary announced the following correspondence: —

From Smithsonian Institution, April 18; Francis H. Appleton, Boston, April 29; Joseph Banvard, Patterson, N. J., April 20; James S. Bryant, Hartford, April 18; A. Crosby, Salem, April 19; Asa Gray, Cambridge, April 19; S. A. Green, April 4; Richard M. Hodges, Cambridge, April 19; J. C. Holmes, Detroit, Mich., April 21; O. W. Holmes, Boston, April 20; Frank E. Hotchkiss, New Haven, April 21; Laburton Johnson, Bradford, April 18; Nathaniel Paine, Worcester, April 20; A. P. Peabody, Cambridge, April 20; G. H. Preble, Charlestown, April 21; W. Hudson Stephens, Lowville, N. Y., April 1; E. M. Stone, Providence, April 22; J. Wingate Thornton, Boston, April 18; B. Westermann & Co., New York, April 19; W. O. White, Keene, N. H., April 28; M. P. Wilder, Boston, April 21.

Mr A. C. Goodell, Jr. alluded briefly to the plan, for some time in contemplation by the Essex Institute of a survey of the Natural History of the county. He congratulated Mr. Hyatt upon the results of his labors in this direction auguring favorably for the completion ere long of this desirable work.

Remarks were made by Mr. James Kimball and others on the papers presented at this meeting.

The Librarian reported the following additions:

By Donation.

ANTHONY, H. B., of Washington, D. C. Congressional Directory by B. P. Poore.

BUTLER, Hon. B. F., M. C. Hoar's Speech in U. S. H. R., March 29, 1871. Edmund's Speech in U. S. S. April 14, 1871. Harlin's Speech in U. S. S. March 29, 1871. Land Office Report for 1868. 3 vols. 8vo.

CONNECTICUT RIVER RAILROAD COMPANY. Annual Report. 1870.

GREENE, S. A., of Boston. Miscellaneous pamphlets, 11.

LEE, JOHN C. Commercial Bulletin for April, 1871.

PACKARD, A. S. Annual Report on the Injurious and Beneficial Insects of Mass.

PEABODY ACADEMY OF SCIENCE. Memoirs, Vol. I, No. 11.

PERRY, REV. W. S., of Geneva, N. Y. Memorial of Rev. Benjamin Dorr, D. D, by Geo. Lewis.

POORE, ALFRED. Miscellaneous pamphlets, 20.

PREBLE, CAPT. GEORGE H., U. S. N. Memoir of William P. Fessenden.

SNOW, E. M., of Providence, R. I. Report of the Births, Marriages and Deaths in Providence for 1868.

STONE, ROBERT. Commerce and Navigation for 1850–54. 2 vols. 8vo. Report on the Finances for 1856. 8vo. Compendium of the U. S. Census for 1850. 8vo. Hymns for the Sanctuary. 12mo. Psalms and Hymns. 1 vol. 12mo. The Christian Examiner, 1826 to 1860. Quarterly Journal of the American Unitarian Association. 1854 to 1859. The Monthly Miscellany, 1841 to 1843. Year Book of the Unitarian Churches, 1856 to 1870. Monthly Journal of the American Unitarian Association, 1860 to 1869. Miscellaneous pamphlets, 25.

SUMNER, CHARLES, U. S. S. Sumner's Speech in U. S. S. March 27, 1871.

WATERS, J. LINTON, of Chicago, Ill. A Western Enterprise. 1871. 8vo pamph. Catalogues of Medals, Tokens.

YOUNG MEN'S ASSOCIATION, OF BUFFALO, N. Y. Annual Report, Feb. 20, 1871.

By Exchange.

BOSTON SOCIETY of NATURAL HISTORY. Proceedings of. Vol. III, sigs. 24, 25.

BOWDOIN COLLEGE. Catalogue, 1870–71.

MASSACHUSETTS HISTORICAL SOCIETY. Proceedings of. 1869–70. 1 vol. 8vo.

NEW JERSEY HISTORICAL SOCIETY. Proceedings of. Vol. II, No. 3. 1871.

ST. GALLISCHE GESELLSCHAFT. Bericht Vereinsjahres, 1868–69.

PUBLISHERS. American Naturalist. Canadian Naturalist. Essex Banner. Gloucester Telegraph. Haverhill Gazette. Lawrence American. Literary World. Little Giant. Lynn Reporter. Medical and Surgical Reporter. Nation. Nature. Peabody Press. Sailor's Magazine and Seamen's Friend. Sotheran's Catalogue. The Book Buyer.

A committee consisting of Messrs. James Kimball, W. Neilson, C. Cooke, W. P. Upham and J. H. Emerton, was appointed to nominate officers for election at the annual meeting.

ANNUAL MEETING, WEDNESDAY, MAY 10, 1871.

THE President in the chair. Records of preceding meeting read.

The following reports on the condition of the Institute were read and accepted.

REPORT OF THE SECRETARY.

In looking back through the record of the year, it becomes the duty of the Secretary to arrange and relate briefly the doings and progress of the Society since the last report. For that purpose it has been found more convenient to dispose of the matter under various heads with the exception of Finance, Library and Museum, which will receive full notice in the reports of the officers of those departments.

Membership. — Twenty-eight persons have been elected and have accepted resident membership, while the loss during the year by death is smaller in numbers than ever before since our society has been so large. Thomas Hunt, died at Salem, May 21, 1870, aged 64 years, 9 months. Daniel Perkins, died at Salem, June 25, 1870, aged 59 years, 4 months. Asahel Huntington, died at his sea side residence in Beverly, Monday, Sept. 5, 1870, aged 72 years. Stephen D. Poole, died at his residence in Lynn, Sept. 22, 1870, aged 53 years, 10 months. Samuel R. Curwen, died at Salem, Nov. 11, 1870, aged 49 years, 10 months.

Correspondence. — This in character and multiplicity continues as extensive as ever.

Publications. — HISTORICAL COLLECTIONS, Vol. X. Parts 2 and 3; and of the BULLETIN, twelve numbers have been issued; also the long delayed and final parts of the PROCEEDINGS.

The BULLETIN, taking the place of the PROCEEDINGS, is now well up to time, and for the coming year arrangements have been made to secure its prompt appearance. This is a very important measure, as it renders the publication more profitable by increasing the number of subscribers and bringing the subscriptions in more promptly.

Meetings.—There have been held of business and public evening meetings, twenty-two; Special, one; Field Meetings, four; at Bradford, Swampscott, West Peabody and Methuen, where the usual courtesy and attentions were extended to the Society by the residents.

At the public evening meetings various valuable and interesting papers have been presented during the winter, to an audience often numbering less than twenty-five persons, yet at other times, when the subject of discussion had been announced in the papers, a fair, and, at times, a large number have attended; this leads to the conclusion that the attendance can be materially augmented by a little previous arrangement, and a notice of speakers and subject in the papers a day or two before the meeting. When we consider the character of these meetings, well repaying the two hours spent at them, it is to be regretted that more do not avail themselves of these free lectures and discussions, the variety of subjects being so great that each must interest some, while none can fail to gain information from all. There have also been a social meeting at Hamilton Hall, and an excursion to Plymouth by steamer, under the auspices of the Institute. The fiftieth anniversary of the formation of the Essex Historical Society was celebrated at the Institute rooms on the twenty-first of last month. An able address was delivered in the afternoon by Mr. A. C. Goodell, and in the evening a company viewed the collections and partook of a collation.

Horticulture. — Three free exhibitions took place in the summer, one each in June, July, and August, the fall exhibition in September lasting three days. These exhibitions were attended by a fair number of visitors. The collection of fruit and flowers, the latter especially, consisted of choicer specimens than were perhaps ever before exhibited at the rooms, showing a more refined taste as well as a greater number of persons interested in Floriculture, the collection being from a larger number of exhibitors than at any previous year, not comprised, as often before, of large showy flowers from a few gardens. By very little effort these exhibitions can be brought to far greater notice in the county and made very much larger, and the society might gain from them a yearly profit, in lieu of barely paying their expenses, as they have every convenience for successfully carrying them forward.

Fair. — During the latter part of October, and the first of November a large fair was held at Mechanic Hall, by the ladies of Salem and vicinity, for the benefit equally of the Salem Oratorio and Essex Institute. It being the opening of the remodelled building, and gotten up with taste, filled with attractive articles, and with many persuasive ways of raising money, the success was such that each society received upwards of sixteen hundred dollars, a sum greatly needed and gratefully received by the Essex Institute.

In General we find the society has improved its time by carrying out its objects and adding to its collections. Many minor improvements have been made during the year and everything kept to the previous standard. There are many things which those immediately interested in the society desire to have done, one — which our President has had in his mind and heart for several years

—the establishing of a Memorial Hall and "Public Library." Here is a grand foundation, which with private and civil coöperation, might easily accomplish the result, and meet a great want in our city; another that, perhaps, might be accomplished at the same time, is the building of a fire-proof room or hall, where the more valuable and unreplaceable portions of the collections might be safely kept; this would also be the means of enlarging our collections by the great amount of valuable documents and paintings that would at once be given or deposited, if we had the facilities for properly guarding them against fire. However, it is not well to be too aspiring, we must be satisfied with our present condition, and when we think of the entire working income of the society for the past ten years as averaging less than fifteen hundred dollars, and never reaching two thousand, while not many years ago it was mere nothing, the amount that has been accomplished is most surprising, and reflects credit on the head of this society, who has since its formation made a frugal allowance do a great amount of work.

Mr. President:—In retiring from the position of Secretary, I desire to call to mind that a year ago to-day we were regretting the absence of our former Secretary, who had left us during the year for a European tour; his return a few weeks since is opportune, in giving us just time to replace his name on the ballot, where we see it to-day, a position that I am heartily glad to have him fill again and feel great satisfaction in handing the Secretary's records over to one whose experience renders him so well fitted to perform the duties of the office.

Respectfully submitted.

JOHN ROBINSON,
Sec'y Essex Institute.